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<p>(21) International Application Number: <b>PCT/GB99/01270</b> (22) International Filing Date: 12 May 1999 (12.05.99) (30) Priority Data: 09/076,507 12 May 1998 (12.05.98) US (71) Applicants: WEATHERFORD/LAMB, INC. [US/US]; c/o CSC - The United States Corporation Company, 1013 Centre Road, Wilmington, DE 19805 (US). LUCAS, Brian, Ronald [GB/GB]; Lucas &amp; Co., 135 Westhall Road, Warrington, Surrey CR6 9HJ (GB). (72) Inventors: ABRAHAMSEN, Egil; 3303 Quiet Lake Drive, Katy, TX 77450 (US). ALBRIGHT, Stephen, Lee; 1709 Hollister, Houston, TX 77055 (US). HOLLINGSWORTH, Jimmy, Lawrence; 117 Summer Morning Court, Lafayette, LA 70508 (US). BEARB, Jean, Donald; 1401 Dove Avenue #15, McAllen, TX 78501 (US). LEICHT, Frederick, Marion; 13522 Raven Hill Drive, Cypress, TX 77429 (US). HAYES, Michael, Warren; 109 Thornwood Circle, Lafayette, LA 70503 (US). BIRDWELL, John, Cleveland; 217 Regal Lane, Liberty, TX 77575 (US). SPEIJ, Leendert; Buizerug, NL-4872 W.Z. Etten-Leur (NL).</p>		<p>(74) Agent: MARKS &amp; CLERK; 4220 Nash Court, Oxford Business Park South, Oxford OX4 2RU (GB). (81) Designated States: AU, CA, CN, JP, NO, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). <b>Published</b> <i>Without international search report and to be republished upon receipt of that report.</i></p>
<p>(54) Title: <b>APPARATUS AND METHOD FOR FACILITATING CONNECTION OF A TUBULAR TO A STRING OF TUBULARS</b> (57) Abstract An apparatus for facilitating the connection or disconnection of a tubular to or from a string of tubulars, which apparatus comprises a weight compensating device (20) which can be suspended from a travelling block (6) or a top drive characterised in that said apparatus further comprises at least one bail (2) which can support a primary elevator (10) and which can, in use, be raised and lowered by said weight compensating device (20) to enable a tubular (32) to be raised and lowered with respect to a string of tubulars and which can move to a load bearing position in which it can raise and lower said string of tubulars. An apparatus for facilitating the connection or disconnection of a tubular to or from a string of tubulars, which apparatus comprises a weight compensating device (20) which can be suspended from a travelling block (6) or a top drive characterised in that said apparatus further comprises a member (42) which can support a primary elevator (10) and which can, in use, be raised and lowered by said weight compensating device (20) to enable a tubular (32) to be raised and lowered with respect to a string of tubulars and which can move to a load bearing position in which it can raise and lower said string of tubulars wherein said weight compensating device (20) is arranged between said travelling block (6) or said top drive and said primary elevator (10). This invention also provides a method, a device and an elevator.</p> <div data-bbox="1003 1155 1356 1858"> </div>		

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APPARATUS AND METHOD FOR FACILITATING CONNECTION OF A  
TUBULAR TO A STRING OF TUBULARS

This invention relates to an apparatus and method for facilitating connection of a tubular to a string of tubulars and particularly, but not exclusively to connecting a stand of casing to a string of casing. This invention also relates to a device for facilitating connection of a tubular to a string of tubulars and to an elevator.

During the drilling of oil and gas wells it is necessary to connect and disconnect tubulars for use therein. Recently, there has been the need to use casing of a very large diameter for lining the well. In particular, modern casing may be forty-eight inches in diameter.

The weight of a single joint of modern casing causes many problems. In particular, casing is usually threaded. When a joint of casing is connected and disconnected from the string of casing, there is a high probability that the threads will become damaged by collisions therebetween.

It has been proposed to use a device called a "single joint compensating elevator" as disclosed in EP-A-0 171 144. The device enables the weight of a single joint to be compensated for, such that when the joint is lowered or raised to or from a string, the effective weight of the joint is zero. A pneumatic bellows or the like allows small adjustments to be made to allow the joint of casing to be made up to the string of casing. The device also allows over compensation to be made, such that upon disconnection of a joint from the string of casing, the joint springs from the string of casing. The device depends from the primary elevator of the rig, with a single joint elevator depending therefrom.

The above described arrangement requires the device

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to be attached to the elevator prior to each connection or disconnection and removed therefrom prior to lowering or raising the string, which is carried out by the primary elevator. This procedure wastes valuable rig  
5 time.

According to the present invention there is provided an apparatus for facilitating the connection or disconnection of a tubular to or from a string of tubulars, which apparatus comprises a weight compensating  
10 device which can be suspended from a travelling block or a top drive characterised in that said apparatus further comprises at least one bail which can support a primary elevator and which can, in use, be raised and lowered by said weight compensating device to enable a tubular to be  
15 raised and lowered with respect to a string of tubulars and which can move to a load bearing position in which it can raise and lower said string of tubulars. The apparatus provides for selectively supporting the at least one joint with the wellbore apparatus.

20 Other features and aspects of the invention are set out in claims 2 to 6.

The invention also provides an apparatus for facilitating the connection or disconnection of a tubular to or from a string of tubulars, which apparatus  
25 comprises a weight compensating device which can be suspended from a travelling block or a top drive characterised in that said apparatus further comprises a member which can support a primary elevator and which can, in use, be raised and lowered by said weight  
30 compensating device to enable a tubular to be raised and lowered with respect to a string of tubulars and which can move to a load bearing position in which it can raise and lower said string of tubulars wherein said weight compensating device is arranged between said travelling  
35 block or said top drive and said primary elevator.

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Other features and aspects of the invention are set out in claims 9 to 11.

5 The invention also provides a method for facilitating the connection or disconnection of a tubular to or from a string of tubulars using the apparatus as of the invention, said method comprising the step of allowing the weight of said primary elevator to be compensated for together with said tubular.

10 The invention also provides an elevator provided with a bearing to facilitate rotation between said elevator and an item held in said elevator wherein said bearing is located on a compressible member compressible in response to weight of the at least one joint on the at least one roller.

15 The invention also provides a device for facilitating the connection or disconnection of a tubular to or from a string of tubulars, said device comprising a rim for attachment to a tubular, said rim suitable for resting on a bearing of a primary elevator. Preferably,  
20 the rim forms part of a cap.

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For a better understanding of the present invention, reference will now be made, by way of example, to the accompanying drawings, in which:

Figure 1a is a side view of a first embodiment of a system in accordance with the present invention, in use, in a first stage of operation;

Figure 1b is a front view of the system of Figure 1a;

Figure 1c is a front view of the system of Figure 1a in a second stage of operation;

Figure 1d is an enlarged view of the system of Figure 1a in said first stage of operation;

Figure 1e is an enlarged view of the system of Figure 1a in said second stage of operation;

Figure 2a is a side view of a second embodiment of a system in accordance with the present invention, in use, in a first stage of operation;

Figure 2b is an enlarged view of part of the system of Figure 2a;

Figure 3a is a view of the system of Figure 2a in a second stage of operation;

Figure 3b is an enlarged view of part of the system of Figure 3a;

Figure 4a is a front view of a third embodiment of an apparatus in accordance with the present invention, in use in a first stage of operation;

Figure 4b is a front view of the apparatus of Figure 4a, in use, in a second stage of operation;

Figure 4c is a side view of the apparatus of Figure 4a, in use;

Figure 5 is a front view of a fourth embodiment of an apparatus in accordance with the present invention, in use;

Figure 6 is a front view of a fifth embodiment of an apparatus in accordance with the present invention, in

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use;

Figure 7a is a view in perspective, of a part of the apparatus of Figure 3a;

Figure 7b is a view in perspective of the part of  
5 the apparatus of Figure 7a;

Figure 7c is an alternative to the part of the apparatus of Figure 7a;

Figure 8 is an alternative arrangement of part of the apparatus of Figure 7a;

10 Figure 9a is a view of a device in accordance with the present invention situated above a tubular;

Figure 9b is a view of the device of Figure 9a located on said tubular; and

15 Figure 9c is a perspective view of the device of Figure 9a.

Referring to Figures 1a - 1e, there is shown a system in accordance with the present invention, generally identified by reference numeral 1.

20 System 1 comprises main bails 2 suspended from the eyes 4 of a rig's travelling block 6. Lower ends 8 of the main bails 2 extend through eyes 9 of an upper elevator 10. Cables 11 support the travelling block 6 in a rig (not shown).

25 Slings 12, made of, for example, steel or synthetic cables, are connected at their top ends to a lower end of the travelling block 6 and at their bottom ends to a lift eye 14 of a joint compensator 20 (which may be any known joint compensator, air cylinder compensator, hydraulic cylinder compensator, or air spring compensator,  
30 including any device for joint compensation disclosed herein.

An optional swivel 18 has its top end connected to a lower eye 22 of the joint compensator 20 and its bottom end connected to a shackle 16 which itself is connected  
35 to a top end of a sub 24. The sub 24 is threadedly

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connected to a standard, commercially available lift assembly 30 which has a lower hook end 26 to which are releasably connected links 28. A lower elevator 40 is connected to the lower ends of the links 28.

5 Both the elevators 10 and 40 may be any suitable known elevator and any elevator disclosed herein. As shown each elevator 10 and 40 is a hinged-door type elevator which is openable to receive a tubular and closable and latchable for holding a tubular. Slip-type  
10 elevators may be used. A stand 36 of two tubular joints 32 and 34 is held by the elevator 40 and supported by the system 1. Although two tubular joints are shown, it is to be understood that the system 1 can support one or a plurality of two, three, four or more joints, including  
15 an entire tubular string extending down into a wellbore.

Figures 1b and 1d show the system 1 at a first stage of operation. The stand 36 of two tubular joints is being lifted by the system 1, and the weight of the stand 36 is being compensated for.

20 Figures 1c and 1e show the single joint compensator 20 in an extended position. The sub 24 abuts the top of the elevator 40. The system can now hold the weight of the entire string of tubulars to which the stand 36 may be attached or detached.

25 Initially, the elevator 40 is latched onto a new stand of tubulars. With the travelling block 6, the stand is lifted to a vertical position. At this point, a shoulder 38 of a shaft 42 of the assembly 30 is bottomed out on a corresponding shoulder 44 of a bowl 46 of the  
30 elevator 10. The compensator 20 is then activated to compensate for the weight of the stand, raising the shaft 42 so that the elevator 10 no longer supports the stand, as shown in Figure 19D.

While the stand's weight is compensated for by the  
35 compensator 20, the stand is easily manipulable and its



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lower end is positioned above and then lowered into a top joint of a tubular string being supported by the rig's slips on the rig floor (not shown). As the stand is made up into the string, the compensator 20 permits the compensated lowering of the stand. When the joint is made up, the rig slips are released; the travelling block system raises the system 1; the shoulder 38 bottoms out on the bowl's shoulder 44; and then the rig's system supports and lowers the entire string. Again the rig slips are set; the elevator 40 is released; and the process of adding an additional stand begins again. A reverse process is used for break-out operations, with the joint compensator 20 activated prior to or following initial lifting up on the string and setting of the rig's slips. As a joint is unscrewed and rising, the joint compensator 20 compensates for the weight of the joint.

Figures 2a and 2b show a system 50 according to the present invention with some parts that are like those of the system 1 and which bear the same identifying numerals. Slings 52 through the eyes 4 connect the tops of joint compensators 51 to the eyes 4. Clamps 53 releasably clamp the lower ends of the joint compensators 51 to the bails 2. Shackles 54 provide for pivoting of the joint compensators 51.

As shown in Figure 2b, an upper part 55 of the tubular 32 is resting on rollers (one shown) 57 rotatably mounted to the elevator 40's body. The rollers 57 are like the rollers in Figure 7a. As shown in Figure 3b, the rollers 57 have been moved down, compressing compression members (not shown, see Figures 5a, 5b). As shown in Figure 3a, the joint compensators 51 are compensating for the weight of the tubulars 32, 34; and the top shackles of the bails 2 are riding up in the eyes 4. The eyes 4 are not at this point bearing the weight through the entire length of the bails 2 of the system 50

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and the tubulars 32, 34. As shown in Figure 3b, the elevator 40, bails 2 and eyes 4 are bearing this weight and the joint compensators 51 are not compensating for the weight of the tubulars. Typical control lines and control apparatus (not shown) are used with the compensators 51.

Figures 4a to 6 show a system 100 according to the present invention with the travelling block 6 with the cables 11 supporting the system 100 in a rig derrick (not shown). The bails 2 support the elevator 10 which holds the tubulars 32, 34 (all as in Figure 1a previously described). Slings 12 support joint compensator 20 below the travelling block 6 and slings 53 connect the joint compensator 20 to the elevator 10 so that the joint compensator (as shown in Figure 4a) compensates for the weight of tubulars held by the elevator 10. Figure 4b shows the eyes 4, bails 2 and elevator 10 supporting the tubulars 32, 34 (and whatever may be connected thereto). The joint compensator 20 may be any compensator disclosed herein (as may be the compensator 70, Figure 4d). Typical control lines and control apparatus are used with the joint compensator 20 (and the compensators 20, 70) or such lines and apparatus as disclosed herein (as is the case for any compensator in Figures 1a, 2a, 3a, and 5).

Figure 5 shows a top drive system 150 according to the present invention suspended below a travelling block 72 with eyes 62 to which are connected a swivel 63, a power train 64 and a top drive 65. A guide dolly 66 holds and guides the top drive 65. Lift eyes 67 connected to the top drive support bails 68 which support a lower elevator 69 (like the elevator 20). A joint compensator 70 is connected to a lower end of a lift sub 72 which is connected to the top drive 65 and slings 71 interconnect the lower elevator 69 and the joint compensator 70.

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Figure 6 shows an embodiment of the system 150 compensating for the weight of a tubular 32 (or a tubular string including the tubular 32). The embodiment of Figure 6 has an elevator 74 instead of the lift eyes 67 of Figure 5. There is also provided a circulating head 73 for use with circulating fluids in the tubulars to be connected and disconnected to or from a string of tubulars.

Figures 7a and 7b show a roller bearing assembly 200 with segments 171, 172, and 173 which are insertable into an elevator to facilitate rotation of a tubular with respect to the elevator. A plurality of rollers 180 are rotatably mounted to the segments 171, 172, and 173. Arms 179 extends inwardly on each side of each roller 180. A base member 174 disposed beneath the roller bearing assembly 200 has three segments 175, 176, and 177 each with two or three upwardly projecting supports 178. In operation a tubular disposed in the bearing assembly 200 is initially supported by the rollers 180. As the tubular is lowered or elevator is raised weight applied to the rollers increases, pushing the segments 171 to 173 down, and thereby arms 179 compress compressible members 199 adjacent each support 178. Eventually the supports 178 (see Figure 7b) project up beyond the top of the rollers 80 and bear the weight of the tubular and other tubulars, if any, attached to it. The compressible members 199 may be made of any suitable compressible and/or cushion material, including, but not limited to elastic materials, rubber, elastomeric materials, and/or a spring or springs of suitable spring force, and/or vented gas filled bladders (in one aspect which are selectively refillable) and/or any combination thereof. Alternatively, no compressible members are used in the system of Figure 7a (or of Figure 9).

Instead of three segments the bearing assembly

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and/or base may be made of two, four or more segments. As shown in Figure 7c, an assembly 300 according to the present invention has a bearing assembly 301 and a base 302 which are not segmented.

5        Bearing assemblies as in Figures 7a and 7c may be used in any suitable tubular handling apparatus or device, including, but not limited to, pipe handlers, pipe positioners, elevators, spiders, and tongs.

10        Figure 8 illustrates a particular embodiment of a bearing system 400 with a plurality of rollers 402 (one shown) useful in assemblies as in Figures 7a and Figure 7c. Each roller 402 is rotatably mounted to a support 404 which is disposed above a compressible member (or material) 406. The support 404 is releasably disposed in  
15        a slot 408 in an elevator body 410. Each support 404 may be held in place with one or more set screws and/or bolts. Such a system may be used in any item listed (pipe handlers, etc.) in the preceding paragraph.

20        Figures 9a and 9b illustrate a lift cap 530 for use with various wellbore tubulars for providing a support surface 532 which can rest on a bearing assembly (as, for example in Figures 7a and 7c). The lift cap 530 has a generally cylindrical body 534 with an end 535 which may be threadedly engageable on a threaded end 540 of a  
25        tubular 542 (Figure 24B). The wall 544 of the tubular 542 is received in a recess 536 around the cap's body 534. Lift/rotation holes 538 (one of two shown in Figure 9a) facilitate lifting and rotation of the cap 530. Set screws 533 through holes 537 secure the cap 530 to the  
30        tubular 540 to prevent unwanted unscrewing of the two. Figure 9c shows a central channel 539 through the lift cap 530.

It is envisaged that the invention is suitable for use with pipe, drill pipe, work strings and casing.

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## CLAIMS:

1. An apparatus for facilitating the connection or disconnection of a tubular to or from a string of tubulars, which apparatus comprises a weight compensating  
5 device (20) which can be suspended from a travelling block (6) or a top drive characterised in that said apparatus further comprises at least one bail (2) which can support a primary elevator (10) and which can, in use, be raised and lowered by said weight compensating  
10 device (20) to enable a tubular (32) to be raised and lowered with respect to a string of tubulars and which can move to a load bearing position in which it can raise and lower said string of tubulars.
2. An apparatus as claimed in Claim 1, wherein said at  
15 least one bail (2) depends from said travelling block (6) or top drive via ears (4).
3. An apparatus as claimed in Claim 2, wherein said ears (4) allow vertical movement of said at least one bail (4) therein.
- 20 4. An apparatus as claimed in Claim 1, 2 or 3, wherein said weight compensating device (20) is arranged between said travelling block (6) or said top drive and said primary elevator.
5. An apparatus as claimed in Claim 4, wherein said  
25 weight compensating device (20) is attached to said primary elevator by lines (71).
6. An apparatus as claimed in any preceding claim, wherein said weight compensating device is attached to said at least one bail (2).
- 30 7. A method for facilitating the connection or disconnection of a tubular to or from a string of tubulars using the apparatus as claimed in any preceding claim, said method comprising the step of allowing the weight of said primary elevator to be compensated for  
35 together with said tubular.

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8. An apparatus for facilitating the connection or disconnection of a tubular to or from a string of tubulars, which apparatus comprises a weight compensating device (20) which can be suspended from a travelling block (6) or a top drive characterised in that said apparatus further comprises a member (42) which can support a primary elevator (10) and which can, in use, be raised and lowered by said weight compensating device (20) to enable a tubular (32) to be raised and lowered with respect to a string of tubulars and which can move to a load bearing position in which it can raise and lower said string of tubulars wherein said weight compensating device (20) is arranged between said travelling block (6) or said top drive and said primary elevator (10).
9. An apparatus as claimed in Claim 8, wherein said primary elevator (10) depends from said travelling block (6) or top drive.
10. An apparatus as claimed in Claim 8 or 9, wherein said member (42) is slideable within said primary elevator (10).
11. An apparatus as claimed in Claim 8, 9 or 10, wherein said weight compensating device (20) is attached to said primary elevator by lines (71).
12. A method for facilitating the connection or disconnection of a tubular to or from a string of tubulars using the apparatus as claimed in any of claims 8 to 11, said method comprising the step of allowing the weight of said primary elevator to be compensated for together with said tubular.
13. An elevator provided with a bearing (57) to facilitate rotation between said elevator (40) and an item held in said elevator (40) wherein said bearing is located on a compressible member (199) compressible in response to weight of the at least one joint on the at

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least one roller.

13. A device for facilitating the connection or disconnection of a tubular to or from a string of tubulars, said device comprising a rim (532) for  
5 attachment to a tubular, said rim suitable for resting on a bearing of a primary elevator.

14. A device as claimed in Claim 13, wherein said rim (532) is part of a cap (530).

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FIG. 1a

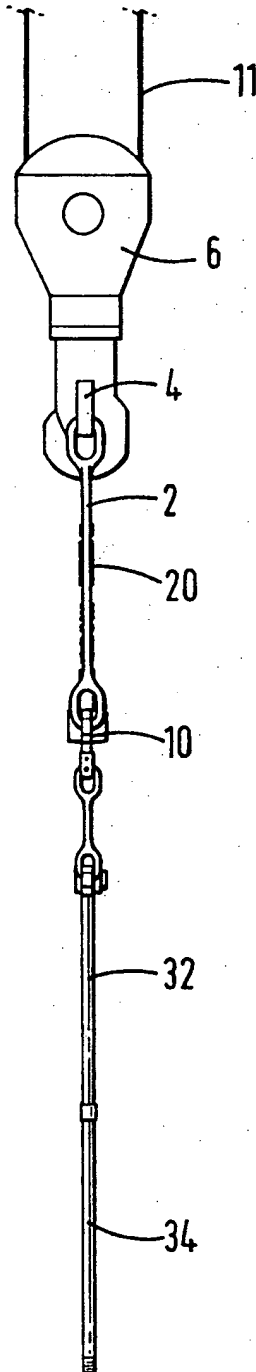


FIG. 1b

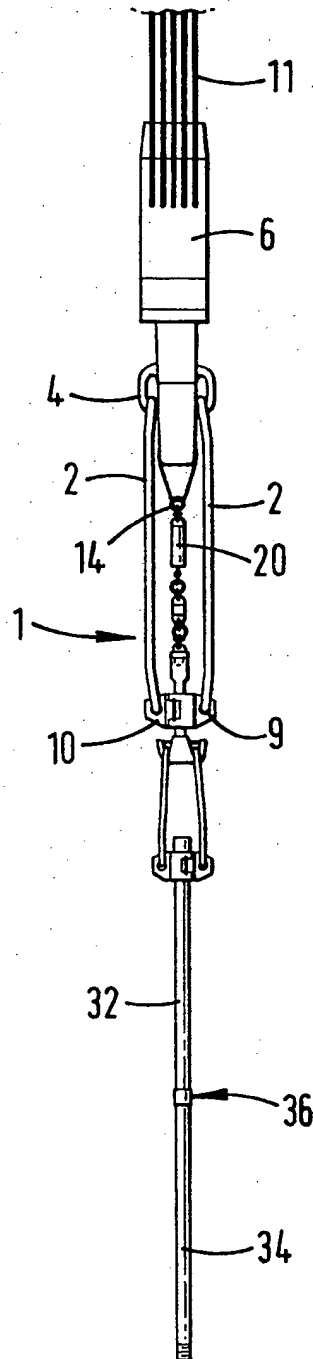
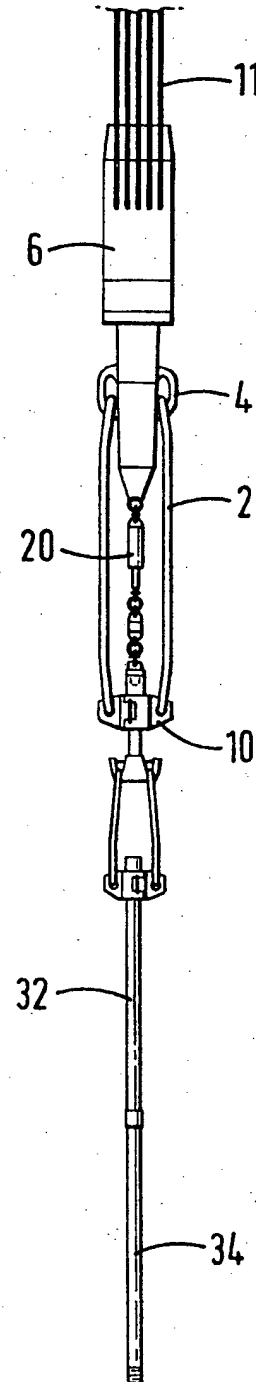


FIG. 1c





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FIG. 1d

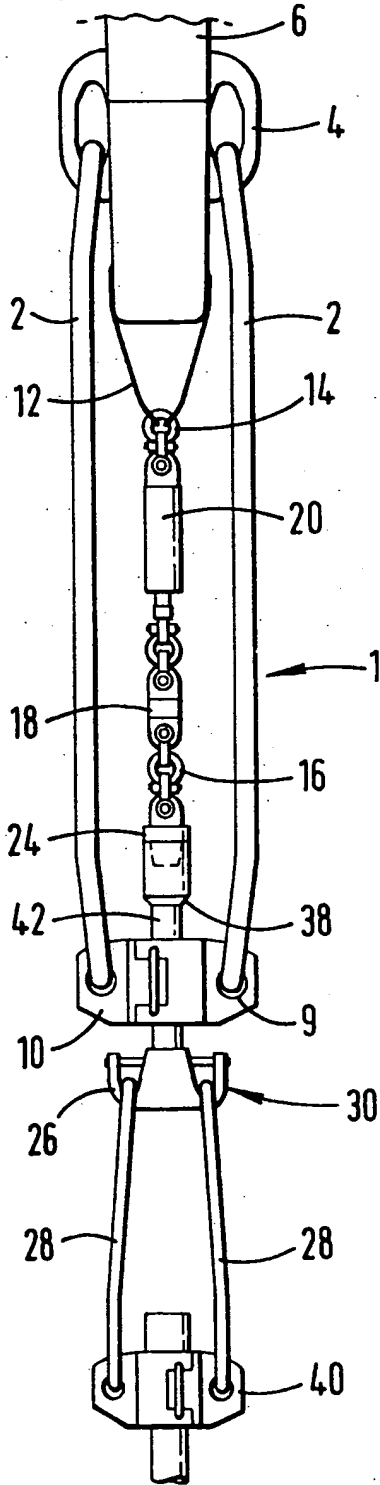
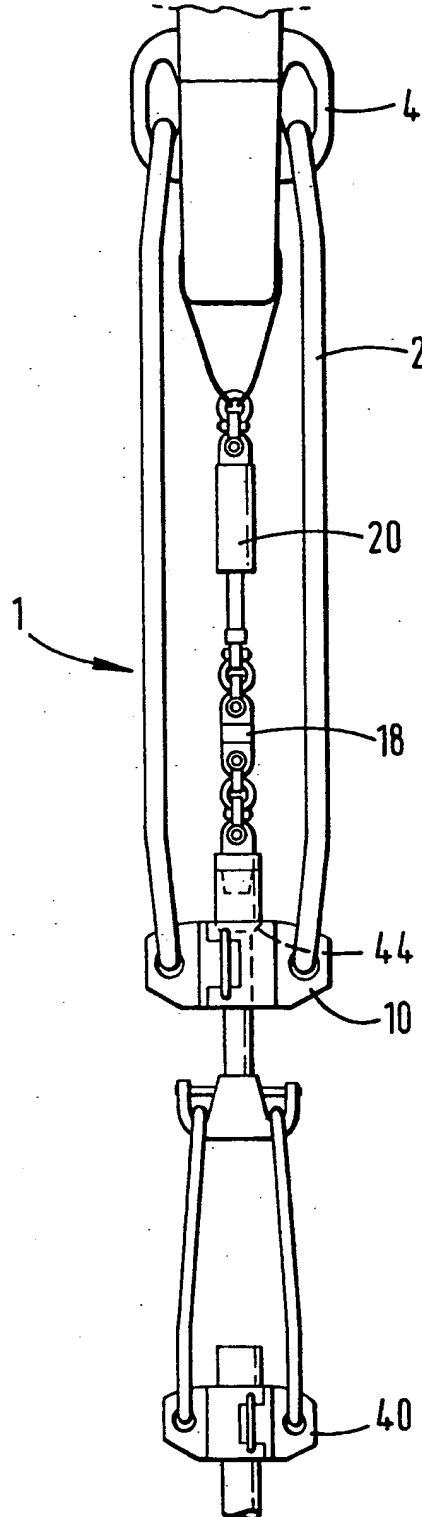


FIG. 1e



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FIG. 2a

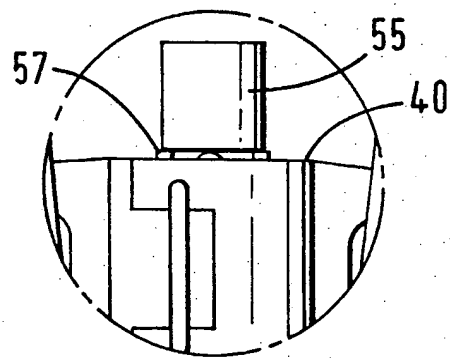
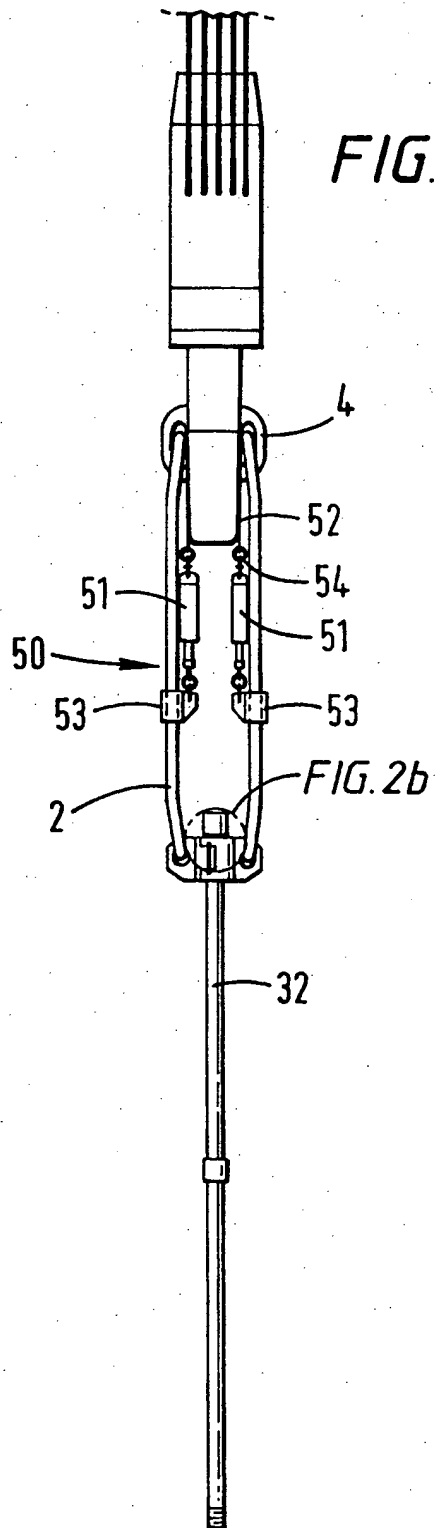


FIG. 2b

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FIG. 3a

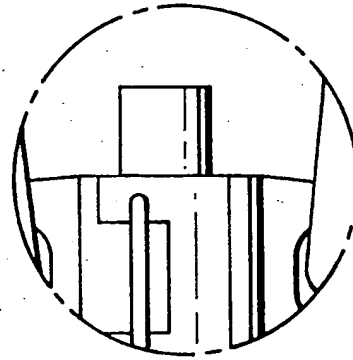
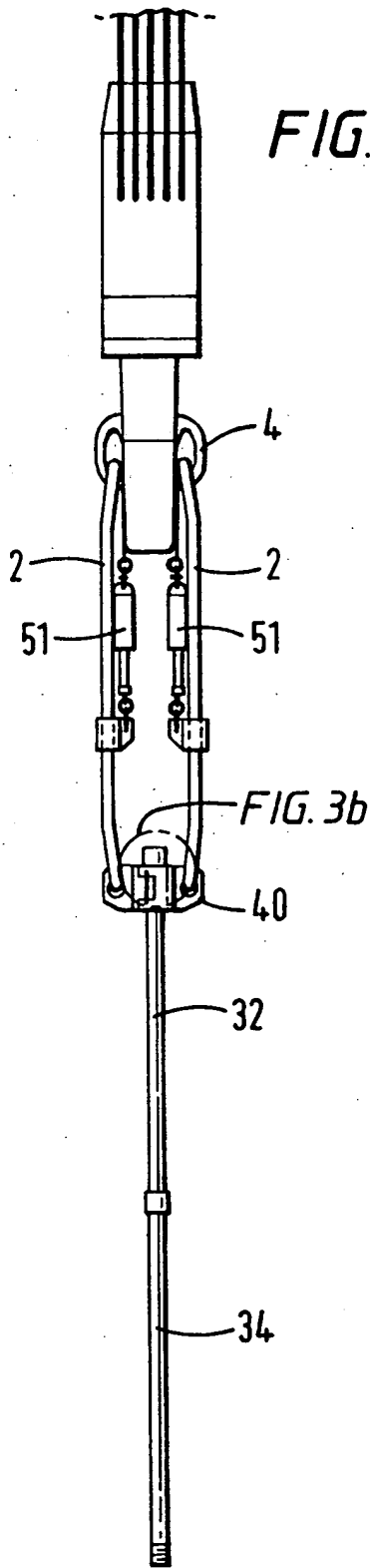


FIG. 3b

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FIG. 4a

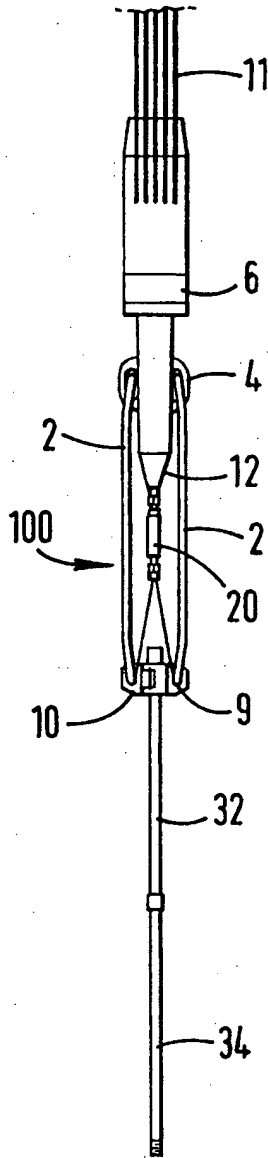


FIG. 4b

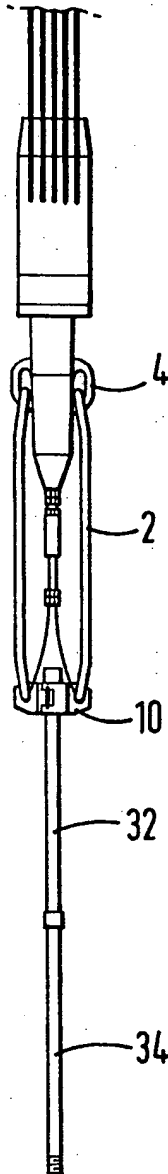
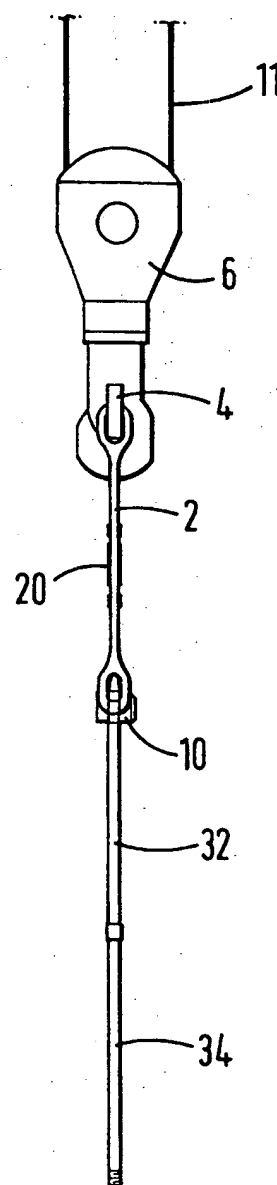


FIG. 4c



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FIG. 5

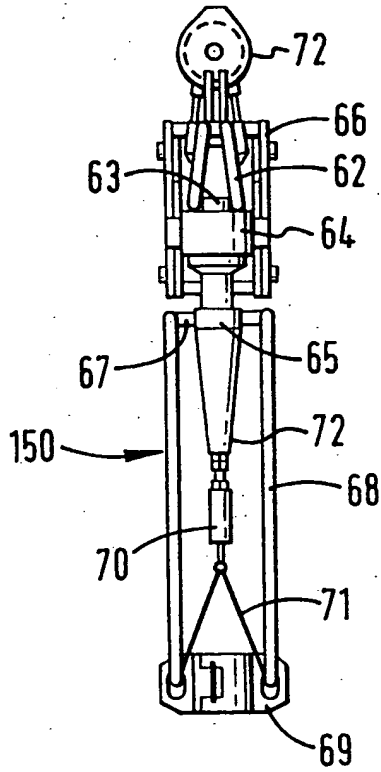


FIG. 6

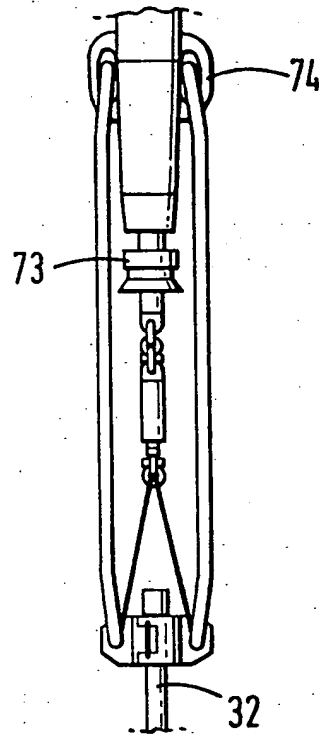


FIG. 7a

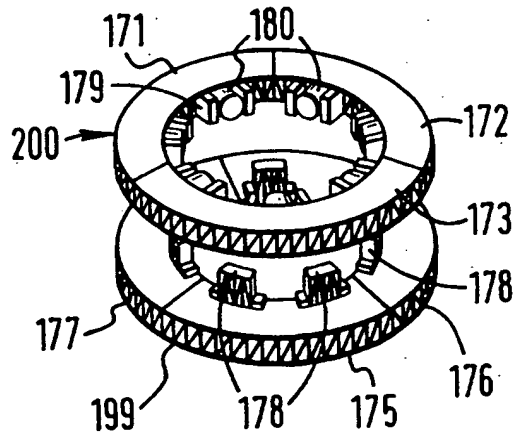
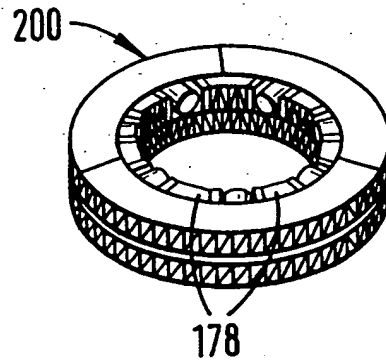


FIG. 7b



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FIG. 7c

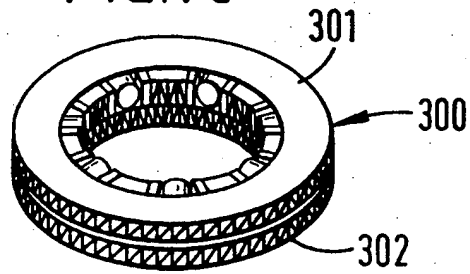


FIG. 8

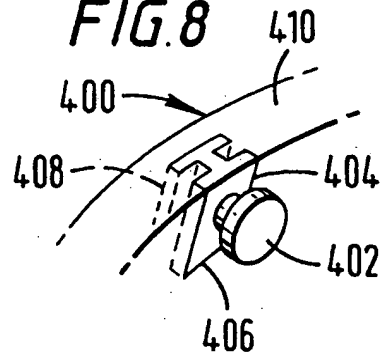


FIG. 9a

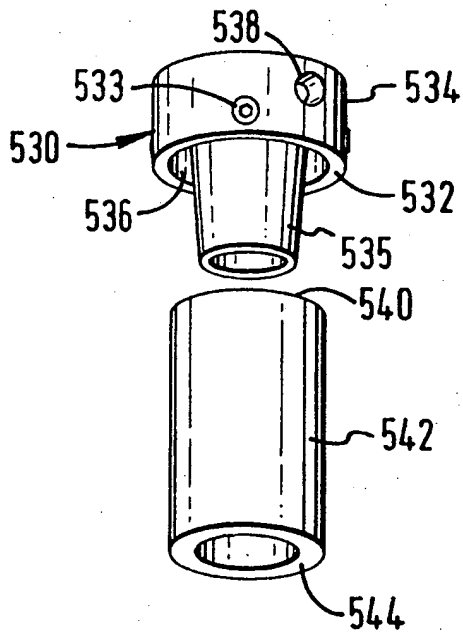


FIG. 9b

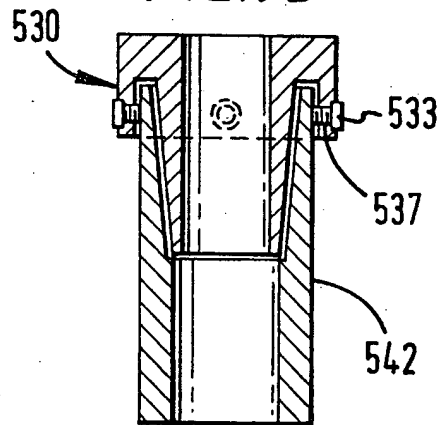
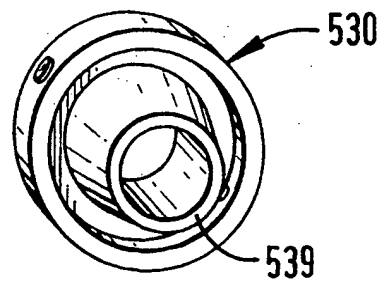


FIG. 9c



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